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L8	1	network adj simulator same stub	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/08/10 14:43
L9	0	703/?ccls. and ((emulat\$ or simulat\$3) near3 stub)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/08/10 14:36

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### 1 [Realistic Large-Scale Online Network Simulation](#)

Xin Liu, Andrew A. Chien

 November 2004 **Proceedings of the 2004 ACM/IEEE conference on Supercomputing**

 Full text available: [pdf\(166.29 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Large-scale network simulation is an important technique for studying the dynamic behavior of networks, network protocols, and emerging classes of distributed application (e.g. Grid, peer-to-peer, etc.) Large-scale and realism are two critical requirements for network simulations of Grid application studies. Our work here extends previous efforts in three key ways. First, we study networks 100x larger than in our previous studies (20,000 routers). Second, at this scale, we study realistic network ...

### 2 [Cluster resource management: An integrated experimental environment for distributed systems and networks](#)

Brian White, Jay Lepreau, Leigh Stoller, Robert Ricci, Shashi Guruprasad, Mac Newbold, Mike Hibler, Chad Barb, Abhijeet Joglekar

 December 2002 **ACM SIGOPS Operating Systems Review**, Volume 36 Issue SI

 Full text available: [pdf\(2.10 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)

Three experimental environments traditionally support network and distributed systems research: network emulators, network simulators, and live networks. The continued use of multiple approaches highlights both the value and inadequacy of each. Netbed, a descendant of Emulab, provides an experimentation facility that integrates these approaches, allowing researchers to configure and access networks composed of emulated, simulated, and wide-area nodes and links. Netbed's primary goals are ease ...

### 3 [Peer-to-peer infrastructure: Scalability and accuracy in a large-scale network emulator](#)

Amin Vahdat, Ken Yocum, Kevin Walsh, Priya Mahadevan, Dejan Kostić, Jeff Chase, David Becker

 December 2002 **ACM SIGOPS Operating Systems Review**, Volume 36 Issue SI

 Full text available: [pdf\(1.64 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)

This paper presents ModelNet, a scalable Internet emulation environment that enables researchers to deploy unmodified software prototypes in a configurable Internet-like environment and subject them to faults and varying network conditions. Edge nodes running user-specified OS and application software are configured to route their packets through a set of ModelNet core nodes, which cooperate to subject the traffic to the bandwidth, congestion constraints, latency, and loss profile of a target ne ...

4 Simulation: A system for simulation, emulation, and deployment of heterogeneous sensor networks

Lewis Girod, Thanos Stathopoulos, Nithya Ramanathan, Jeremy Elson, Deborah Estrin, Eric Osterweil, Tom Schoellhammer

November 2004 **Proceedings of the 2nd international conference on Embedded networked sensor systems**

Full text available:  pdf(345.48 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)


Recently deployed Wireless Sensor Network systems (WSNs) are increasingly following *heterogeneous* designs, incorporating a mixture of elements with widely varying capabilities. The development and deployment of WSNs rides heavily on the availability of simulation, emulation, visualization and analysis support. In this work, we develop tools specifically to support *heterogeneous* systems, as well as to support the measurement and visualization of *operational* ...

**Keywords:** EmStar, TinyOS, real code simulation, sensor networks

5 Technical papers: A solver for the network testbed mapping problem

Robert Ricci, Chris Alfeld, Jay Lepreau

April 2003 **ACM SIGCOMM Computer Communication Review**, Volume 33 Issue 2


Full text available:  pdf(383.46 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

Network experiments of many types, especially emulation, require the ability to map virtual resources requested by an experimenter onto available physical resources. These resources include hosts, routers, switches, and the links that connect them. Experimenter requests, such as nodes with special hardware or software, must be satisfied, and bottleneck links and other scarce resources in the physical topology should be conserved when physical resources are shared. In the face of these constraint ...

6 Fast detection of communication patterns in distributed executions

Thomas Kunz, Michiel F. H. Seuren

November 1997 **Proceedings of the 1997 conference of the Centre for Advanced Studies on Collaborative research**

Full text available:  pdf(4.21 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Understanding distributed applications is a tedious and difficult task. Visualizations based on process-time diagrams are often used to obtain a better understanding of the execution of the application. The visualization tool we use is Poet, an event tracer developed at the University of Waterloo. However, these diagrams are often very complex and do not provide the user with the desired overview of the application. In our experience, such tools display repeated occurrences of non-trivial commun ...

7 Conference abstracts


January 1977 **Proceedings of the 5th annual ACM computer science conference**

Full text available:  pdf(3.14 MB) Additional Information: [full citation](#), [abstract](#), [index terms](#)

One problem in computer program testing arises when errors are found and corrected after a portion of the tests have run properly. How can it be shown that a fix to one area of the code does not adversely affect the execution of another area? What is needed is a quantitative method for assuring that new program modifications do not introduce new errors into the code. This model considers the retest philosophy that every program instruction that could possibly be reached and tested from the ...

8 Higher Bandwidth X


J. Danskin

October 1994 **Proceedings of the second ACM international conference on Multimedia**Full text available:  pdf(701.71 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Network bandwidth has always been a key issue for multimedia protocols. Many potential users of networked multimedia protocols will continue to have low bandwidth network connections for some time: copper wire ISDN, infra-red, cellular modems, etc.. Compression provides potential relief for users of slow networks by increasing effective bandwidth. Higher Bandwidth X (HBX) introduces a new technique, based on arithmetic coding and statistical modeling, for compressing structured data. Applie ...

**9 Personal distributed computing: the Alto and Ethernet software**


Butler Lampson

January 1986 **Proceedings of the ACM Conference on The history of personal workstations**Full text available:  pdf(3.00 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The personal distributed computing system based on the Alto and the Ethernet was a major effort to make computers help people to think and communicate. The paper describes the complex and diverse collection of software that was built to pursue this goal, ranging from operating systems, programming environments, and communications software to printing and file servers, user interfaces, and applications such as editors, illustrators, and mail systems.

**10 Spinach: a liberty-based simulator for programmable network interface architectures**

Paul Willmann, Michael Brogioli, Vijay S. Pai

June 2004 **ACM SIGPLAN Notices , Proceedings of the 2004 ACM SIGPLAN/SIGBED conference on Languages, compilers, and tools for embedded systems**, Volume 39 Issue 7Full text available:  pdf(336.99 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper presents Spinach, a new simulator toolset specifically designed to target programmable network interface architectures. Spinach models both system components that are common to all programmable environments (e.g., ALUs, control and data paths, registers, instruction processing) and components that are specific to the embedded systems and network interface environments (e.g., software-controlled scratchpad memory, hardware assists for DMA and medium access control). Spinach is built on ...

**Keywords:** embedded systems, programmable network interfaces, simulation**11 Modeling methodology: Parallel execution of a sequential network simulator**

Kevin G. Jones, Samir R. Das

December 2000 **Proceedings of the 32nd conference on Winter simulation**Full text available:  pdf(72.42 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

Parallel discrete event simulation (PDES) techniques have not yet made a substantial impact on the network simulation community because of the need to recast the simulation models using a new set of tools. To address this problem, we present a case study in transparently parallelizing a widely used network simulator, called *ns*. The use of this parallel *ns* does not require the modeler to learn any new tools or complex PDES techniques. The paper describes our approach and design choi ...

**12 Applying parallel discrete event simulation to network emulation**

Rob Simmonds, Russell Bradford, Brian Unger

May 2000 **Proceedings of the fourteenth workshop on Parallel and distributed simulation**

Full text available:  [pdf\(767.64 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The simulation of wide area computer networks is one area where the benefits of parallel simulation have been clearly demonstrated. Here we present a description of a system that uses a parallel discrete event simulator to act as a high speed network emulator. With this, real Internet Protocol (IP) traffic generated by application programs running on user workstations can interact with modelled traffic in the emulator, thus providing a controlled test environment for distributed app ...

**Keywords:** Internet protocol (IP), computer network emulation, conservative protocol, critical channel traversing, parallel discrete event simulation (PDES), real-time simulation

13 Improving Scalability of Network Emulation through Parallelism and Abstraction

Cameron Kiddle, Rob Simmonds, Brian Unger

April 2005 **Proceedings of the 38th annual Symposium on Simulation**

Full text available:  [pdf\(208.63 KB\)](#)

Additional Information: [full citation](#), [abstract](#)

One approach to network emulation involves simulating a virtual network with a real-time network simulator and providing an I/O interface that enables interaction between real hosts and the virtual network. This allows real protocols and applications to be tested in a controlled and repeatable environment. To reflect conditions of large networks such as the Internet it is important that the emulation environment be scalable. This paper examines improvements in scalability of the virtual network ...

**Keywords:** Scalable Network Emulation, Parallel Discrete Event Simulation, Simulation Abstraction, Fluid Simulation

14 A new instructional operating system

David A. Holland, Ada T. Lim, Margo I. Seltzer

February 2002 **ACM SIGCSE Bulletin , Proceedings of the 33rd SIGCSE technical symposium on Computer science education**, Volume 34 Issue 1

Full text available:  [pdf\(469.63 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

This paper presents a new instructional operating system, OS/161, and simulated execution environment, System/161, for use in teaching an introductory undergraduate operating systems course. We describe the new system, the assignments used in our course, and our experience teaching using the new system.

15 Wireless and Mobile Networks Performance: EMWIN:: emulating a mobile wireless network using a wired network

Pei Zheng, Lionel M. Ni

September 2002 **Proceedings of the 5th ACM international workshop on Wireless mobile multimedia**

Full text available:  [pdf\(620.08 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Test and performance evaluation of protocols and algorithms in mobile wireless networks is known to be challenging. Due to the highly varying characteristics of mobile wireless networks, one cannot merely rely on either network simulation or a testbed. Network emulation provides a controllable and reproducible environment, yet it generally lacks the support for the emulation of network topology and mobility, which are extremely critical in


mobile wireless network research. We introduce EMWIN, a ...

**Keywords:** mobile wireless network, mobility, network emulation, performance evaluation

16 Towards target-level testing and debugging tools for embedded software

Harry Koehnemann, Timothy Lindquist

October 1993 **Proceedings of the conference on TRI-Ada '93**

Full text available:  [pdf\(1.28 MB\)](#)

Additional Information: [full citation](#), [references](#), [index terms](#)



17 Computer networks (CN): EmuNET: a real-time network emulator

Ayman Kayssi, Ali El-Haj-Mahmoud

March 2004 **Proceedings of the 2004 ACM symposium on Applied computing**

Full text available:  [pdf\(691.99 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

New protocols and network applications must be extensively tested before deployment on the Internet. In this paper, we describe the design and implementation of EmuNET, a lightweight, portable, configurable, and extendable network emulator, which can be used to emulate a wide variety of network characteristics and conditions inside a laboratory environment. Protocols and applications can be tested, without modification, directly on top of the emulated network. The emulator can be used to test pr ...

**Keywords:** delay, jitter, network emulation, queuing disciplines



18 NeuroAnimator: fast neural network emulation and control of physics-based models

Radek Grzeszczuk, Demetri Terzopoulos, Geoffrey Hinton

July 1998 **Proceedings of the 25th annual conference on Computer graphics and interactive techniques**

Full text available:  [pdf\(28.26 MB\)](#)

Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

**Keywords:** backpropagation, dynamical systems, learning, motion control, neural networks, physics-based animation, simulation



19 The NetWire emulator: a tool for teaching and understanding networks

Enrico Carniani, Renzo Davoli

June 2001 **ACM SIGCSE Bulletin , Proceedings of the 6th annual conference on Innovation and technology in computer science education**, Volume 33 Issue 3

Full text available:  [pdf\(485.43 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The evolution of the parallel computing theory has shown over years the need for complex and reliable emulation tools for teaching, learning and developing new distributed algorithms in a realistic network environment. *NetWire[emu]* is a distributed architecture designed for educational and research purposes which provides a synthetic and realistic network environment that may be used to teach and learn parallel algorithms (or parallel operating systems) as well as to research and develop ...

**Keywords:** TCL programmable, distributed simulation, graphical shell, network emulation, physical characteristics, synchronous operation





**20 SENS: A Sensor, Environment and Network Simulator**

Sameer Sundresh, Wooyoung Kim, Gul Agha

April 2004 **Proceedings of the 37th annual symposium on Simulation**Full text available:  [pdf \(203.24 KB\)](#) Additional Information: [full citation](#), [abstract](#), [citations](#)

Recent advances in micro electro-mechanical systems and VLSI lithography have enabled the miniaturization of sensors and controllers. Such miniaturization facilitates the deployment of large-scale wireless sensor networks (WSNs). However, the considerable cost of deploying and maintaining large-scale WSNs for experimental purposes makes simulation useful in developing dependable and portable WSN applications. SENS is a customizable sensor network simulator for WSN applications, consisting of interchangeable ...

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IEEE JNL IEEE Journal or Magazine

IEE JNL IEE Journal or Magazine

IEEE CNF IEEE Conference Proceeding

IEE CNF IEE Conference Proceeding

IEEE STD IEEE Standard

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Application#	Patent#	Status	Date Filed	Title	Inventor Name
<a href="#">60202190</a>	Not Issued	159	05/05/2000	INTERNET PROTOCOL TRANSPORT	KLEVANS, RICHARD L
<a href="#">60124063</a>	Not Issued	159	03/12/1999	IMPLEMENTATION OF MULTIPROTOCOL LABEL SWITCHING ROUTERS	KLEVANS, RICHARD L.
<a href="#">09849010</a>	Not Issued	080	05/04/2001	METHOD AND SYSTEM FOR HARDWARE SIMULATION	KLEVANS, RICHARD L.
<a href="#">09674315</a>	<a href="#">6885677</a>	150	10/26/2000	MULTIPROTOCOL LABEL SWITCHING ROUTERS	KLEVANS, RICHARD L.

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